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(71) Applicant(s)
Glasdon Group Limited

(Incorporated in the United Kingdom)

Preston New Road, Blackpool, Lancashire, FY4 4UL, United Kingdom

(72) Inventor(s)
John Lloyd

(74) Agent and/or Address for Service
Marks & Clerk
Suite 301, Sunlight House, Quay Street, MANCHESTER, M3 3JY, United Kingdom

# (54) Bomb-resistant container

(57) A bomb-resistant container, particularly for use as a refuse bin comprising at least two interfitting spaced tubes. The tubes are formed of a spiral winding of fibres provided in a resin base (5, 7) and being separated by a layer of a compressible material (6). Any fractures created in the inner tube by an explosion are not immediately propagated through the compressible material to the outer tube, reducing the risk of the outer tube fracturing. Also disclosed is a refuse bin comprising a blast-resistant body and having a removable liner of a frangible material suspended in the body with substantial clearance therefrom.

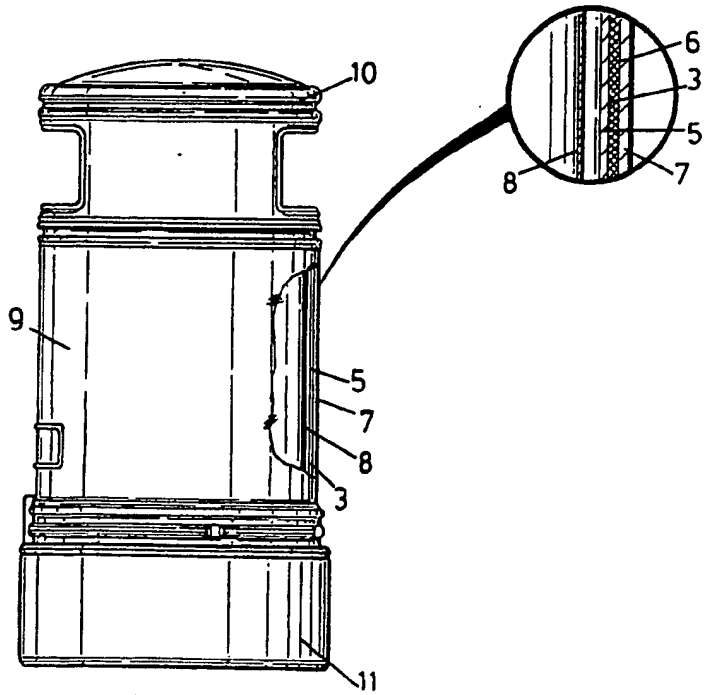


FIG.1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

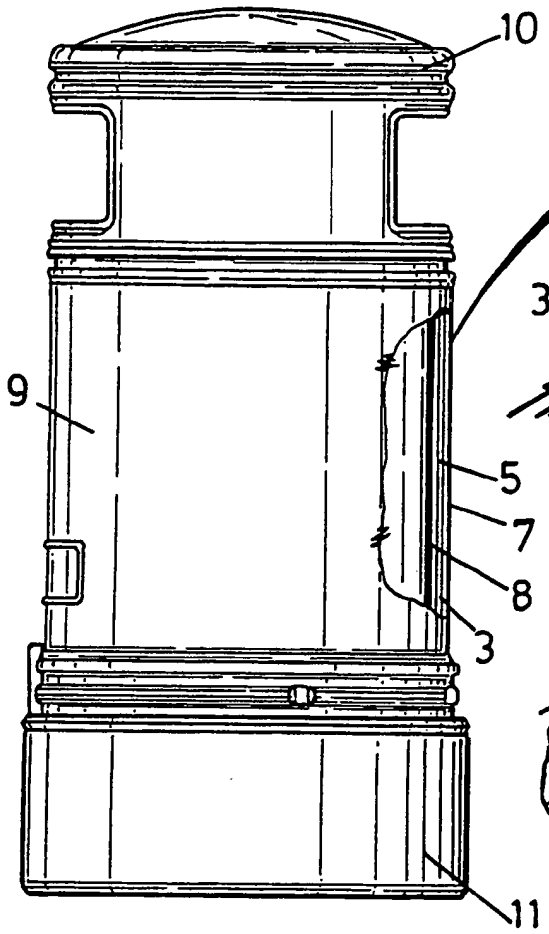


FIG.1

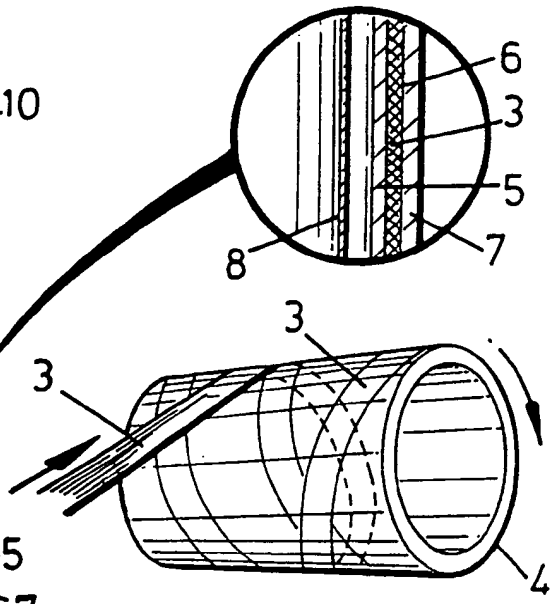


FIG.2

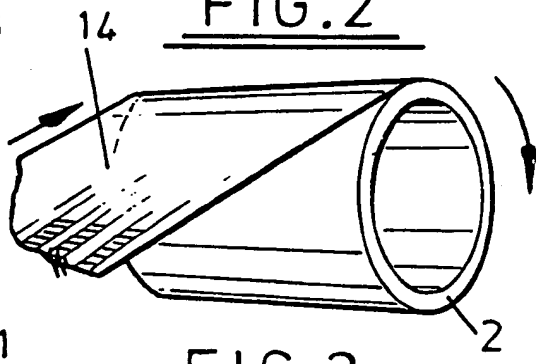


FIG.3

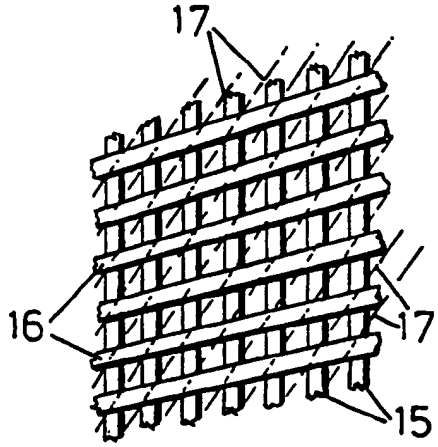


FIG.4

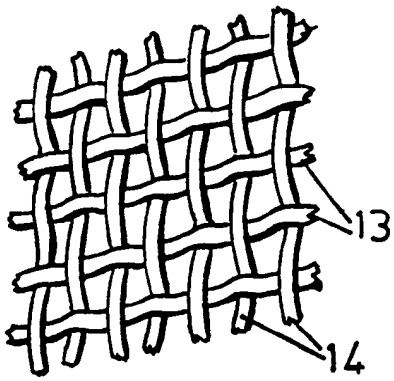


FIG.5

# BOMB-RESISTANT CONTAINER

The present invention relates to a bomb-resistant container, particularly but not exclusively to a bomb-resistant container for use as a refuse bin.

It should be appreciated that the term "bomb-resistant container" used herein and in the claims is intended to refer to containers which are capable of containing or reducing the blast generated by an explosive device, or of channelling a blast away from persons in the vicinity of the container. The term "spiral" as used herein and in the claims is intended to cover both helical and spiral winding of material.

It is a known tactic of terrorist groups to place bombs in refuse bins in public places because a bin provides a convenient hiding place and because the bin shatters when the bomb explodes, which can add greatly to the damage caused. This has resulted in the removal of refuse bins from some public areas, for example, railway stations, but it is not practicable or desirable to remove refuse bins from all public places.

It is known to manufacture explosion resistant casings for the transport of munitions or explosives, which casings are capable of withstanding explosions. Such casings are typically constructed of outer and inner housings formed of a metal such as sheet steel, the housings being separated by a compressible or concussion resistant material such as, for example, vermiculite, a foam plastic, or layers of a material formed of aramid fibres.

These casings are generally suitable for the purpose for which they are designed, but tend to be expensive and very bulky and heavy. They are also unsuitable for use as refuse containers because they are too heavy to be manipulated so that they may be emptied.

EP-A-0 299 902 describes a blast-resistant container comprising dish-shaped outer and inner housings formed of steel which are separated by a layer of a vermiculite mixture. A removable basket is provided to enable the container to be used as a refuse bin. GB-A-2 222 667 describes a bomb containment device for use as a receptacle for a suspect explosive device which comprises a tube formed of a winding of filament glass fibre incorporated into a bonding resin

material, and provided with a net suspended mid-way up the tube to form a support for a suspect package.

These containers are either too bulky, heavy and expensive to be used in large numbers as refuse bins, or do not offer sufficient blast resistance to a bomb.

Refuse bins are typically provided in a town or city in large numbers by public authorities, and must therefore be as inexpensive as possible. Further, the actual chance of a bomb being placed in any one bin is very small, so that the extra cost of providing bomb-resistant bins must not be so great as to deter the public authority from providing the safer bins. It is also necessary that the bin may be emptied easily and quickly and that any removable covers or refuse containers provided therein must not be permitted to fragment in such a way as to form dangerous projectiles in the event of a bomb exploding in the bin.

It is an object of the present invention to obviate or mitigate the above-mentioned disadvantages.

According to a first aspect of the present invention there is provided a bomb-resistant container comprising a body having at least two interfitting spaced tubes, the tubes each being formed of a spiral winding of fibres provided in a resin base and being separated by a layer of a compressible material.

The use of tubes formed of a fibrous material together with a layer of compressible material has significant cost and weight advantages over prior constructions. Further, any fractures created in the inner tube by an explosion do not immediately propagate across the compressible material to the outer tube.

The tubes are preferably formed of a fire resistant material. A plurality of tubes may be provided, with a layer of compressible material being provided between each pair of adjacent tubes. The tubes are preferably formed of helical windings of glass fibres impregnated with a thermosetting resin. Advantageously, the tubes are laminates with consecutive layers of helical windings being formed with the helical angle altered between each winding so that the orientation of fibres in consecutive layers is not parallel.

The tubes are advantageously further provided with fibres oriented along the axis of the tube, these axially oriented fibres being

provided either in a woven or a stitched material, which is spirally wound onto the tube. The material containing the axially oriented fibres may be provided as a separate layer. Alternatively, the tubes may be formed of the material containing the axially oriented fibres.

The compressible material may be an elastomeric material, a resilient material or a gas. Suitable examples of compressible materials which may be employed in the invention are air, "coremat" (a felt-like material), textile reinforced rubber, dry glass filaments (without resin impregnation), or a low density foam, and combinations of such materials.

According to a second aspect of the present invention there is provided a method of making a bomb-resistant container comprising forming a first cylindrical tube by spirally winding fibres provided in a resin base on a mandrel, winding at least one layer of a compressible material onto the first cylindrical tube and spirally winding further fibres in a resin base onto the compressible layer to form a second cylindrical tube.

A plurality of tubes may be created, with a layer of compressible material being provided between each adjacent tube. Each tube may be formed of a plurality of helical windings of fibres, with the helical angle of each winding being altered between each winding so that the orientation of the fibres in each layer is not parallel.

According to a third aspect of the present invention, there is provided a refuse bin comprising a body of a blast resistant material, and having a removable liner of a frangible material suspended in the body with substantial clearance therefrom.

Preferably, the body further comprises at least one layer of a compressible material. Most preferably, there is provided two interfitting spaced tubes of the blast resistant material, the tubes of material being separated by the layer of the compressible material. The blast resistant material may be formed of a spiral winding of fibres in a resin base. The compressible material may be an elastomeric material, a resilient material or a gas.

The liner may be a plastics sack but is preferably a thin walled reusable plastics lining tub, and may be supported on the upper rim of the inner tube, although it is preferable that as little of the liner as possible protrudes above the level of the top of the tube. Handles

provided on the liner must be formed in such a way so that they do not become potentially dangerous projectiles in the event of an explosion. Suitable handles may be an aperture or recess provided in the wall of the lining, or may be formed of a rubber or elastomeric material, rope or tape, or may be removable so that it is only affixed in place when the liner is removed.

Thus, even if a bomb is placed in the bin immediately adjacent to the side of the liner, it will still not be directly adjacent the blast reducing layers, and therefore the damage caused to the bin will be reduced.

A refuse bin according to the present invention may be manufactured in accordance with any of the first to third aspects of the invention, either singly or in combination. The refuse bin may further comprise a cover either for weather protection or to restrict the size of objects entering the bin. The cover may be a side apertured hood and may be of a lightweight plastics material. Such a hood would simply be blown upwards from the bin by the force of an explosion and would fall back to earth without causing too much damage.

The refuse bin may also be provided with external decoration, which may be directly applied to the outermost tube, or which may be provided on a separate sleeve to fit over the bin. The sleeve may be affixed to the outermost tube, or may simply be placed over the bin. The sleeve may be open at the base allowing the bin to be affixed to the ground and blast escaping from the junction of the base and side wall of the blast container to vent beneath the outer sleeve thus reducing the risk that the sleeve will become fragmented and propelled outwards as dangerous shrapnel.

The present invention also provides, as a fourth aspect, a method of increasing the bomb-resistance of existing bins, the method comprising removing an existing liner from the bin and replacing it with a bomb resistant liner comprising at least one layer comprising a tube formed of a helical winding of fibres provided in a resin base, at least one layer of a compressible material externally of the tube and a liner for receiving refuse.

The modified bin with greater bomb resistance will have less space for receiving refuse than the bin prior to modification by the

method of the present invention, but the added safety aspects of the bin compensate for this disadvantage. This method of retro-fitting existing bins has significant cost savings over completely replacing all existing bins, the body of the existing bin becoming the outer tube of the bomb resistant bin.

One embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a part-sectional view of a refuse bin according to the present invention;

Figure 2 shows a strip of reinforcement material being helically wound around a tube;

Figure 3 shows a woven or stitched reinforcement material being wound around a tube;

Figure 4 shows an enlarged view of a woven reinforcement material; and

Figure 5 shows an enlarged view of a stitched reinforcement material.

Referring to the drawings, a refuse bin having a body 1 comprising two composite/glass fibre tubes 2 is manufactured by helically winding resin impregnated glass fibres 3 onto a steel mandrel 4 (as shown in Fig. 2). A plurality of layers of helical winding are employed to form a tube 5, having the helical angle of the windings reversed in consecutive layers so that the orientations of fibres in each layer are not parallel. Once the desired thickness of tube has been attained, the winding is discontinued and layers of a compressible material 6 are wound over the tube 5.

The compressible material 6, which may, for example, be a high compressibility felt-like material as sold under the trade mark "coremat", is wound onto the tube 5 until the desired thickness is attained. The thicknesses of the tubes and compressible material are dependent on the strength of blast that the bin is designed to withstand.

The winding is again discontinued, and resumed with the resin impregnated glass fibres 3 to form an outer tube 7 onto the compressible material 6 and the central tube 5 to trap the compressible material between the two tubes 5, 7.

A removable inner receptacle 8 for receiving refuse is then positioned in the central tube 5. The inner receptacle 8 is a thin walled reusable plastics lining tub, closed at one end to allow refuse to be placed therein. The inner receptacle is of smaller diameter than the inner surface of the central tube 5 to define an air gap between the receptacle and the tube. The inner receptacle is supported in the central tube on the upper rim of the tube. Apertures or recesses are provided in the top of the receptacle to act as handles (not shown).

A lightweight plastics decorative sleeve 9 is affixed to the outside of the outer tube. This decorative sleeve 9 may be designed to give a cast iron appearance or a smooth or textured plastics appearance.

A side-apertured hood 10 of a lightweight plastics material is further fitted to the top of the refuse bin 1 to give weather protection to the contents of the bin and to restrict the size of object permitted to be placed in the bin.

A base 11 is also provided, which closes the lower end of the tubes. Once assembled, the bin may be anchored into place on the ground in the usual manner, the base providing ground anchorage points (not shown).

Referring to Figures 3 to 5 of the accompanying drawings, it is advantageous to introduce fibres which run substantially axially to the tube to reduce the risk of an explosion separating the tube into two halves in a plane normal to the tube axis. The axial fibres are introduced to the tube 2 in webs of woven (see Figure 4) or stitched (see Figure 5) fabric 12, which may be formed of glass fibres. The strips of fabric are spirally wound around the tube as shown in Figure 3. The woven or stitched fabrics may be balanced, having warp and weft fibres of equal strength, or may be biased to provide more strength in one direction. Woven fabrics as shown in Figure 4 have individual strands which are kinked in the warp 13 and weft 14 and are therefore capable of some extension when a load is applied thereto and the kinks are forced to straighten. This slightly elastic extension is an advantage in a blast resistant structure, as it is a further way of absorbing more energy without breaking the fibres. Stitched fabrics as shown in Figure 3 do not have any kinks in the fibres and cannot therefore extend further. Vertical and horizontal strands 15,

16 are simply overlaid and stitched together with stitching 17. The vertical and horizontal strands are therefore already fully extended when a load such as an explosion is applied to them. Stitched fabrics also make it possible to orient the strands other than at right angles to each other.

If a bomb were to explode in the bin, the inner refuse receptacle 8 would immediately break up and disintegrate with the force of the explosion. The air gap around the inner receptacle 8 ensures that even if a bomb were placed directly adjacent the receptacle wall, the shock of the explosion will not be adjacent the wall of the inner tube 5, which reduces the damage caused to the tube.

The force of the explosion will be taken up by the central tube 5, which may fracture with the stress. The discontinuity formed by the layer of compressible material prevents any fractures in the central tube propagating to the outer tube 7, thus reducing the risk of the outer tube shattering. The force of the explosion is further taken up by the compressible material, and any pieces of the central tube and inner receptacle which are travelling outwards from the explosion site will be retained by the outer tube.

The hood 10 will be blown upwards and probably fragmented by the force of the explosion, and will fall back to earth. The hood is relatively harmless as it is formed of a lightweight material.

Modifications to the bin include variations in the number of tubes and layers of compressible material provided, the material with which the tubes are formed, and the compressible material used, which may, for example, be an elastomeric material, a resilient material or gas, i.e. air, textile reinforced rubber, dry glass filaments or a low density foam. If the compressible material used is air, the tubes must be manufactured separately and assembled in concentric alignment using spacers. The fibres oriented along the tube axis may be provided in addition to the tubes, or alternatively may form part of the tubes.

CLAIMS

1. A bomb-resistant container comprising a body having at least two interfitting spaced tubes, the tubes each being formed of a spiral winding of fibres provided in a resin base and being separated by a layer of a compressible material.

2. A container as claimed in claim 1, wherein the tubes are formed of a fire resistant material.

3. A container as claimed in claim 1 or 2, wherein at least two of tubes are provided, with a layer of compressible material being provided between each pair of adjacent tubes.

4. A container as claimed in any preceding claim, wherein the tubes are formed of helical windings of glass fibres impregnated with a thermosetting resin.

5. A container as claimed in any preceding claim, wherein the tubes are provided with fibres oriented along the axis of the tube.

6. A container as claimed in claim 5, wherein the axially oriented fibres are provided in a woven or stitched material

7. A container as claimed in any preceding claim, wherein the tubes are laminates with consecutive layers of helical windings being formed with the helical angle altered between each winding so that the orientation of fibres in consecutive layers is not parallel

8. A container as claimed in any preceding claim, wherein at least one layer of a material containing fibres oriented along the axis of the tube is provided.

9. A container as claimed in any preceding claim, wherein the compressible material is an elastomeric material, a resilient material or a gas.

10. A container as claimed in claim 9, wherein the compressible material is air.

11. A container as claimed in claim 9, wherein the compressible material is textile reinforced rubber.

12. A container as claimed in claim 9, wherein the compressible material is dry glass filaments.

13. A container as claimed in claim 9, wherein the compressible material is a low density foam.

14. A container as claimed in any preceding claim adapted for use

as a refuse bin.

15. A method of making a bomb-resistant container comprising forming a first cylindrical tube by spirally winding fibres provided in a resin base on a mandrel, winding at least one layer of a compressible material onto the first cylindrical tube and spirally winding further fibres in a resin base onto the compressible layer to form a second cylindrical tube.

16. A method as claimed in claim 15, wherein more than two tubes are created, with a layer of compressible material being formed between each adjacent pair of tubes.

17. A method as claimed in claim 15 or 16, wherein each tube is formed of a plurality of helical windings of fibres, with the helical angle being altered between each winding so that the orientation of the fibres in each layer is not parallel.

18. A method as claimed in Claims 15-17, wherein additional fibres having their axes oriented along the axis of the tube are wound onto the tube.

19. A refuse bin manufactured according to the method of any of claims 15 to 17.

20. A refuse bin comprising a blast resistant body, and having a removable liner of a frangible material suspended in the body with substantial clearance therefrom.

21. A bin as claimed in claim 20, wherein the body further comprises at least one layer of a compressible material.

22. A bin as claimed in claim 20 or 21, wherein the blast resistant material is formed of a spiral winding of fibres in a resin base.

23. A bin as claimed in any of claims 20-22, wherein the blast resistant material includes fibres having their axes oriented along the axis of the body.

24. A bin as claimed in any of claims 21-23, wherein the compressible material is an elastomeric material, a resilient material or a gas.

25. A bin as claimed in any of claims 19 to 24, wherein the liner is a plastics sack.

26. A bin as claimed in any of claims 19 to 24, wherein the liner is a thin walled reusable plastics lining tub.

27. A bin as claimed in claim 26, wherein the liner is supported on the upper rim of the inner tube.

28. A bin as claimed in any of claims 19 to 26, wherein handles are provided on the liner in the form of an aperture or recess provided in the wall of the lining; or are formed of a rubber or elastomeric material, rope or tape; or is removable so that it is only affixed in place when the liner is removed.

29. A refuse bin as claimed in any of claims 14 or 19 to 28, further comprising a cover in the form of a side apertured hood.

30. A bin as claimed in claim 29, wherein the cover is formed of a lightweight plastics material.

31. A bin as claimed in any of claims 14 or 19 to 30, provided with external decoration.

32. A bin as claimed in claim 31, wherein the external decoration is directly applied to the outer surface of the bin.

33. A bin as claimed in claim 31, wherein the external decoration is provided on a separate sleeve to fit over the bin.

34. A bin as claimed in claim 33, wherein the sleeve is affixed to the outermost tube.

35. A bin as claimed in claim 33 or 34, wherein the sleeve is open at the base of the bin, allowing the bin to be affixed to the ground.

36. A method of increasing the bomb-resistance of an existing bin, the method comprising removing an existing liner from the bin and replacing it with a bomb resistant liner comprising at least one layer formed of a tube of a spiral winding of fibres provided in a resin base, at least one layer of a compressible material externally of the tube and a liner for receiving refuse.

| Patents Act 1977<br>Examiner's report to the Comptroller under Section 17<br>(The Search report) | Application number<br>GB 9313219.9 |
|---|---|
| **Relevant Technical Fields**<br>(i) UK Cl (Ed.M) A4A (AE); A5A; F3C (CP2, CPK)<br>(ii) Int Cl (Ed.5) A62C 3/00, 39/00; B65F 1/14, 1/16; F42B 39/14, 39/24; F42D 5/004 | Search Examiner<br>DR N R CURTIS<br>Date of completion of Search<br>21 SEPTEMBER 1994 |
| **Databases** (see below)<br>(i) UK Patent Office collections of GB, EP, WO and US patent specifications.<br>(ii) ONLINE DATABASE: WPI | Documents considered relevant following a search in respect of Claims :-<br>1 TO 19, 25 TO 35 |

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**P:** Document published on or after the declared priority date but before the filing date of the present application.

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**&:** Member of the same patent family; corresponding document.

| Category | Identity of document and relevant passages | | Relevant to claim(s) |
|---|---|---|---|
| Y | GB 2222667 A | (THE POST OFFICE) see page 3, lines 7 to 10 | 1-6, 8-16, 18, 19, 25-27, 29-36 |
| Y | GB 2041178 A | (MICHAEL SACKS) see Figure 1, column 1 lines 107 to 127 | 1-6, 8-16, 18, 19, 25-27, 29-36 |
| Y | EP 0299902 A2 | (KOOR METALS LTD) see column 1, lines 21 to 32 | 1-6, 8-16, 18, 19, 25-27, 39-36 |
| Y | WPI Abstract Accession No. 87-362866/51 and ZA 8700674. 22.08.86 (see abstract) | | 1-6, 8-16, 18-19, 25-27, 29-36 |

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